Problems of development of mathematical models and creation of innovative products in the Republic of Kazakhstan

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***Abstract*—The characteristic of innovation activity of an enterprise are quite complex and their informative analysis based on heuristic methods is difficult. This predetermines the need to apply different models and modeling methods. The economic-mathematical model of the innovation strategy of an enterprise should include, from our point of view, a description of the enterprise as a subject of innovative activity and the mechanism of its new development. It is assumed that the use of economic and mathematical models allows to obtain new knowledge about innovative development of an enterprise. The article is devoted to the study of the problem developing mathematical models of process optimization, modeling innovative development of enterprises in Kazakhstan. Analysis of the existing scientific tools for modeling innovation development of various economic systems has led to the conclusion that for its use in modeling the innovative strategy of enterprise, it is necessary to clarify the specified toolkit based on specifics of this type of an enterprise. It should be born in mind that modeling should be preceded by the stage of analysis of innovative activity of an enterprise, including not only current situation, but also possibilities of its transformation in accordance with the goals of the enterprise.**

Keywords— innovative products, optimization, innovative strategy, modeling, economic and mathematical model, problems.

I. INTRODUCTION

Innovation processes of one or another orientation are carried out in all spheres of social and economic activity of state within the framework of enterprises and institutions of various forms of ownership. At enterprises, innovation processes should cover scientific, informational, design and production activities. It is also impossible not to take into account economic, administrative and socio-cultural activities of innovative processes in the organization.

If consider the essence of the concept of "Innovative development" the most fully reveals the essence of innovation development as “A special innovation orientation of goals, ways to achieve them, a special innovation “setting” the mechanism of state influence on the economy and market self-organization, due to the preferential orientation of links in all sectors of the economy to the integrated use of innovations in the production of goods and services, redistribution of forms and regulatory methods for impact performance.” Consider the essence of the concept of "Innovative development"[1].

II. MATERIALS AND METHODS (MODEL)

The process of innovation development can effectively proceed only in certain conditions created by the innovation environment. Innovation environment is a prerequisite for the formation of an effective innovation system. Therefore, it is necessary to consider in more detail the essence of this category.

The concept of “innovation environment” appeared in the early 80s as a means of analyzing the system conditions provided to economic entities for the production of new ideas, products, the creation of new industries and the development of new markets [2].

As for the term "innovation", it is understood by researchers in different ways. There are four directions for understanding innovation [3]:

-change (F. Valenta, L. Voldachek, Yu.V. Yakovets, etc.)

- the end result (N.N. Molchanov, L.M. Gokhberg, L. Utkin, S.Yu. Glazyev, D.V. Sokolov, V.N. Arkhangelsky, R.A. Fatkhutdinov, V.N. Gunin, A.B. Krutik, S.D. Ilyenkova, G.S. Hamidov, G.D.Kovalev and others);

- Progress (V.N. Lapin, A. Tviss, B. Santo, S. V. Valdaipev, F.F. Bezdushny, G. A. Smirnova, A. B. Titov, V. P. Vorobev, etc.) ;

- a set of activities (F. Nixon).

III. Results and Discussion

The article considers the issues of finding the optimal managerial impact on the process of creating and mastering the release of new products in enterprises. In order to make informed decisions on changing the range of products, an economic-mathematical model has been proposed.

$$p = \text{Traffic} = \text{demand Rate/Service Rate} \quad (1)$$

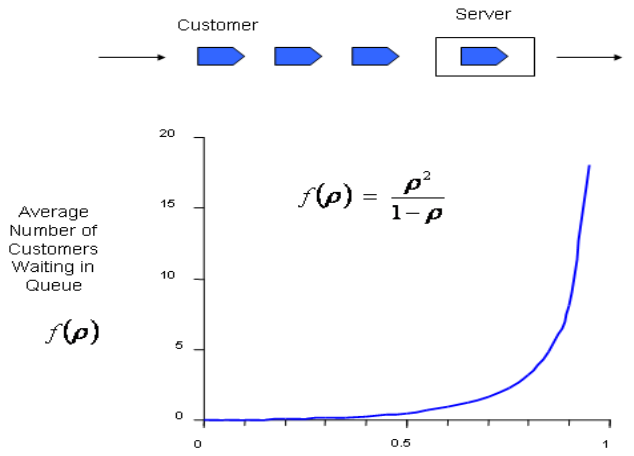

Fig. 1. Single-Server Queuing System

An important mathematical problem in manufacturing is the performance analysis of a production line. A typical production line consists of a series of workstations that perform different operations. Jobs flow through the line to be processed at each station. Buffers between stations hold the output of one station and allow it to wait as input to the next. A finite buffer can fill and block output from an upstream station or can empty and starve a downstream station for input. Blocking and starving are key mechanisms of the complex interactions between queues that form in the line.

Another real-world mathematical problem, common to many industries, is the distribution of material and products from plants to customers. For a network of origins and destinations, there are many shipping alternatives, including choices of transportation mode (e.g., road, rail, air) and geographical routes. Some key decisions are routing options over the network, and shipping frequencies on network links. As shown in Figure 2, routing options involve shipping direct, via a terminal or distribution center, and by a combination of routes. These options affect distances traveled and times in transit, which in turn affect transportation and inventory costs. Shipping frequency decisions also affect these costs. Transportation costs favor large infrequent shipments, while inventory costs favor small frequent shipments. Trade-offs between these costs are complex for large networks, and finding the optimal solution is a challenging mathematical problem. In addition to decisions for operations of a given network, there are major strategic decisions, such as the selection and location of distribution centers.

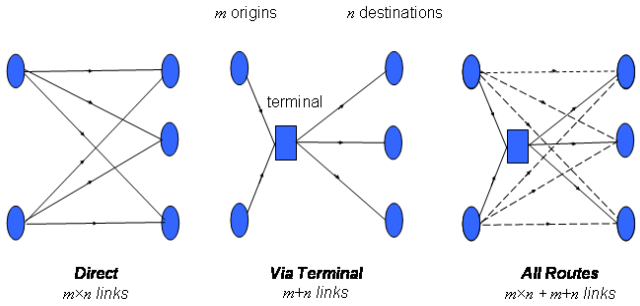

Fig. 2. Network Routing Options

Other OR topics requiring mathematical analysis are inventory control (when to reorder material to avoid shortages under demand uncertainty), manufacturing operations (what size of production run will minimize sum of inventory and production setup costs), location planning (where to locate the hub to serve markets with minimal travel distances), and facility layout (how to design airport terminals to minimize walking distances, maximize number of gates, allow for future expansion, and conform to government regulations).

The studies were modern scientific concepts of economic theory, innovation theory and management theory, the fundamental works of domestic and foreign scientists devoted to the study of strategic management, innovation management, fundamental scientific propositions of the regional economy, cluster theory, innovation and innovation activities, scientific research of domestic and foreign scientists, set out in periodical literature, materials of scientific conferences, theses and monographs Asia, revealing the patterns of development of the innovation sphere at the regional level.

The author substantiates the theoretical position based on the application of such general scientific methods and techniques as a systematic and integrated approach, a method of comparative analysis, a method of scientific abstraction, analysis, and synthesis, economic and mathematical methods, etc. Statistics can provide objective goals using individual numbers, and also convincing evidence to substantiate positions or provide a certain level of confidence in the company's activities. Statistics may indicate a relationship. A careful analysis of the data can reveal the links between two variables, such as specific business proposals and changes in income or dissatisfied customers and products purchased.

Recently, the idea of innovation as the final result of innovation activity, as well as the process of its implementation, has dominated.

Results: Mathematical models of various aspects of innovation activity (spatial and temporal aspects of technology replacement, fluctuations in the development of innovation processes, statistical features of the emergence of innovations in various industries) were built and analyzed in the monograph by D. Sakhal. A distinctive feature of these

models is a high level of abstraction and aggregation when describing the corresponding innovative phenomena. [4, p. 65]

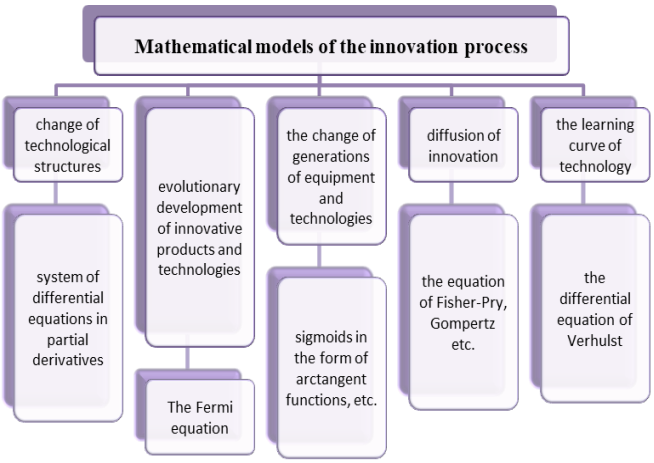

Fig. 3. Classification of mathematical models of the innovation process

The methods of mathematical modeling are based on the construction of models of the type: y = f (x), where y is the effective feature; x - factorial factor affecting the resultant.

Correlation is a kind of factor connection and is a partial dependence of the resultant feature (y) on the factor feature (x). On (y), the influence of other factors (ε) is also possible. The influence of the factor characteristics taken into account is determined by the method of scientific abstraction from other factors. As a result, it becomes possible to establish patterns of interaction and obtain quantitative characteristics of the correlation connection. Correlation and regression analysis as one of the methods of mathematical modeling allows us to obtain a more reliable and reliable predictive value of the final result.

Mathematical modeling is necessary to understand and accurately predict the behavior of complex systems.

These models allow you to solve important problems, for example:

- system behavior prediction and optimization;
- control system design;
- system response description.

Innovations are classified according to such characteristics as the source, the scope of innovation, the scale of application and the degree of their high cost.

The developer gets the following features:

- determine simulation conditions using experimental design techniques, probability distributions, and other test vectors;
- perform simulations using various numerical methods and parallel computations;
- post-process results.

The MATLAB and Simulink product families allow you to create a model of almost any system. Among others, the following types of systems are supported:

- linear and nonlinear;
- static and dynamic;
- deterministic and stochastic;
- discrete and continuous.

Different modeling environments allow you to choose how to describe the system. The system can be described programmatically, symbolically, using flowcharts or state machines.

With the help of specialized MathWorks products, you can create mathematical models for use in various areas of activity:

- computational finance - portfolio optimization, risk assessment, economic forecasting;
- physical modeling - mechanical, electrical, hydraulic systems modeling, transmission modeling;
- automotive industry - power train modeling and calibration;
- computational biology - analysis of gene expression, sequence analysis, metabolism modeling;
- aerospace systems - modeling environment and aerodynamics.

In the process of generating and implementing innovations in enterprises and organizations, several successive stages usually alternate:

- the creation and transfer of new intellectual property objects and the development of an innovative project;
- project management at the stages of preparation and organization of the production of innovative goods;
- commercialization of innovations.

The first stage includes basic research and R & D; mechanism for the deployment of an innovative product, including benchmarking, selection of ideas, business plan, feasibility study of the project. The innovativeness of the organization at this stage can be characterized by the following indicators [5; 6]:

1) the number of innovative ideas put forward by employees of the organization;

2) the ratio of implemented innovative ideas to the total number of proposals put forward;

3) the time elapsed from the moment of initiating a new proposal to the launch of an innovative project.

In the second stage, the mechanism for organizing the production of innovative goods includes laboratory and bench tests of components and assemblies, quality certification, optimization of costs for ensuring product quality. A special role is played by sampling, built on a scientific basis. Innovation activity is associated with a large number of risks, and the better the quality control of an innovative product is, the lower the costs associated with the organization of production will be, and in the event of project failure, there will be losses.

When optimizing the cost of providing a given level of quality innovation, it is necessary to take into account such

parameters as the costs associated with consulting, with staff, technology costs, costs for other resources that may be associated with the purchase of specialized databases, etc., other costs associated with stimulating the development of production.

In the third stage, the mechanism of commercialization of innovation includes market research, break-even analysis, production planning, economic assessment of the limits of innovation, the creation of a monitoring system in market changes. Here you can recommend the use of a number of standard indicators, for example, the rate of return on innovation (KRI). It can be calculated, both for successfully completed projects, and for those preparing for implementation on the basis of prepared forecast calculations: $KRI = \frac{FRI}{ZI}$,

where FRI is the financial result from innovation or from innovation activity. It is formed from additional income, from the excess of actual income as a result of the more efficient entry into the market, from reduction of transaction costs, from the profit of the organization, etc.

ZI - the cost of innovation, which may be depending on the specifics of innovation. Costs are generated from the additional costs of an organization related to the sale of a new product, from the actual costs of an organization related to the launch of a new product on the market, from the amount of transaction costs associated with the implementation of new services of the organization, the costs of an organization related to the penetration of its products into a new market segment etc.

Thus, we can write:

$$KRI = \frac{FRI}{ZI} \rightarrow max \quad (1)$$

Increase the profits of the organization. The profit share (DP) from the sale of new products in the total profit for the last years can be written as follows:

$$DP = \frac{PI}{PO} \rightarrow max \quad (2)$$

where, PI is the organization's profit from the sale of new products in recent years;

PO - the total profit of the organization in recent years.

These indicators are based on the assumption that it is innovations that are the resources of an organization that can provide it with long-lasting competitive advantages.

When formalizing the economic and mathematical model of making management decisions to improve the effectiveness of an organization's innovation activity, it is natural to assume that the goals of innovation development, the specifics of innovation activity, and the capabilities of organizations may differ significantly from each other [7; 8]. The profitability of innovation, striving for the maximum, can act as a target function of the task of increasing the efficiency of the organization's innovation activities. The target function may be the share of profits from the sale of new products in the total amount of profits in recent years, also tending to the maximum.

The key role in building a model of innovative development of high-tech enterprises is played by the concepts of products (products or services created by an enterprise), resources, production processes and the environment.

The set of products taken into account in the development of an innovative strategy of ECP can be represented as the set $P + N = \{k : k_1, k_2, ..., k_n, k_n \geq 0, n: n = 1,\}$, and the resources used by ECP as elements of the set $k \in P + N$.

In this case, it is necessary to take into account that there are factors (price, etc.) that limit the use of certain types of resources (financial, labor, etc.). This restriction can be formalized as follows: $k \in K$, where $K \in P + N$ is the set of resources available for ETP.

It should be noted that the boundaries of this set may change over time, i.e. K = K(t). At the same time, the products created by the enterprise are also an element of a certain set of products $l \in P + N$, the components of which correspond to the volume of output by the enterprise of specific types of products.

Then the production set of ECPs, which is a set of all sets of products manufactured by them, can be written as: $L \in P + N$. The structure and boundaries of set L are determined by endogenous (resource set K) and exogenous (first of all, demand for certain types of products) factors. Like the resource, the production set can change over time: L = L (t).

The capabilities of high-tech enterprises to transform their resources into final products are characterized by available technologies that form the set $M = \{m_1, m_2, m_i,\}$, each element m_j of which corresponds to one of the technological processes available to the enterprise and defines the mapping mj: K → L The technological set M can change in time similarly to the resource and production sets: M = M (t). It is possible to change the number of its elements since technologies can be used in an enterprise with any degree of intensity [9, p. 89].

Initial resources and technologies, as well as the types and volumes of products produced by high-tech enterprises, are selected in the process of making management decisions d (t), taken at time t and determining production activity of the enterprise.

To provide the necessary support for innovation processes, it is necessary to create an appropriate infrastructure that would carry out financial, information, consulting, marketing and other types of support for innovation projects.

For further economic and mathematical constructions, the potential of a certain subject (object) will be understood as its ability to implement (use for the purpose of implementation - for an object) a certain activity. Potential assessment can naturally be based on the results of the implementation of these opportunities.

The structural diagram of the optimization model, which allows understanding the sequence of work is shown in the figure below.

The use of optimal programming as a tool for justifying the innovation program of an enterprise has some peculiarities related to the fact that the specification of the system of variables and constraints should differ significantly from those specified in the optimization models of the

production structure, machine and tractor fleet, etc., used as the closest analogue. There should be differences in the preparation of initial information.

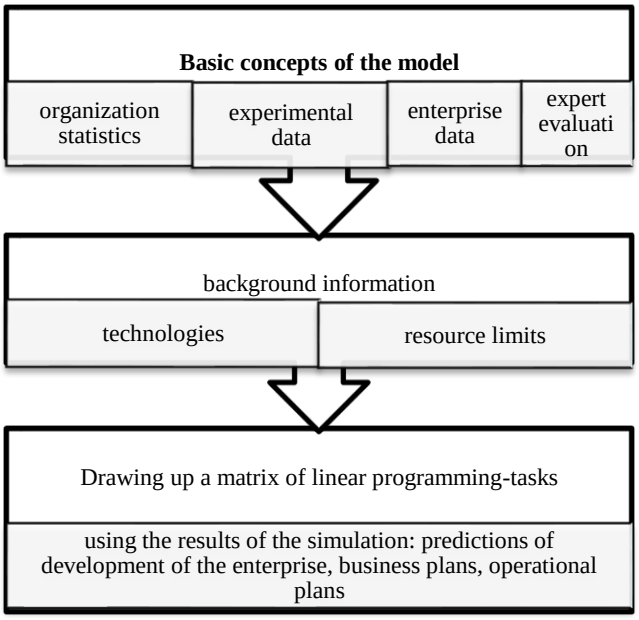

Fig. 4. Stages of development of the economic-mathematical model "The choice of innovative priorities for the development of the organization"

Among the questions that need to be answered when developing an innovation strategy for an enterprise is what should be given preference in order to create a "critical mass" of innovations capable of significant positive changes in the entire economic system [10] - a whole range of innovations or one or two, but large. In fact, it is a question of choosing the direction of development of the enterprise. In our opinion, an effective toolkit for the selection of areas of investment is modeling, based on the system analysis methodology. Obviously, after appropriate adaptation, this tool is quite applicable to substantiate the strategy and tactics of the innovation process.

The verification of the main qualitative characteristics of the model (adequacy for important properties, sensitivity to the source data, stability of solutions - robustness, etc.) confirmed its suitability for solving the selected problem.

The first criterion of optimality will be, accordingly, the maximum value of the profitability of innovation, the second - the maximum value of the share of profits received from the sale of new products in the total profit, the third - the maximum relative growth of the company's market value compared to the relative growth of the industry market over recent years. The maximum value of the objective function in each case must be achieved in the economic space, represented as constraints.

Description of the process of multicriteria optimization of the efficiency of innovation activities of the organization

Definition and construction of possible target functions-criterion

- The level of profitability of innovation→ max
- The share of profit received from the sale of new products in the total profit → max
- Relative growth of the market value of the organization compared to the relative growth of the industry market → max

Possible components of the restriction system:

Organizational and economic mechanism of innovation generation and implementation

- Mechanism for the creation and transfer of intellectual property
- Mechanism of innovative project deployment

→ **A model** that describes the distribution of time between the accumulation of information in the search for innovative ideas and the creation of innovation by the organization.

Indicators: the number of innovative ideas put forward by the staff of the organization; the ratio of implemented innovative ideas to the total number of proposals the time elapsed from the initiation of a new proposal to the launch of an innovative project

- Mechanism of innovative project management at the design stage;
- Mechanism of organization of production of innovative goods

→ **Model of optimization** of costs for providing a given level of quality; costs associated with consulting, personnel, technology, and other external resources.

Indicators: the number of new products, services, businesses that the organization brought to the market;

The ratio of the number of consumers, customers who consider the organization innovative, to their total number.

- Mechanism of innovation commercialization

→ effectiveness of the organization's innovation activities.

Fig. 5. Description of the process of a multi-criteria task of increasing the

In the practical solution of such a task in each specific case, the priority of target functions should be determined, taking into account the relevant restrictions. After that, you can proceed to consider the next most important objective function. Separately, if necessary, the task of optimizing the cost of innovation can be solved.

A model describing the distribution of time between the accumulation of information in the process of searching for innovative ideas and the creation of innovation can be used in drawing up a system of limitations to the above-described multi-objective optimization task [11; 12].

The results of the study can be schematically represented as follows (Fig. 4, 5 above).

A distinctive feature of this approach is the consistent consideration of the stages of generating and implementing innovations using various models.

To modify the management model of innovative organizations it is proposed:

1) the inclusion in the linear process of the production of existing products/services of the Technological Development Unit (targeted R & D);

2) the division of operating activities into production and assembly activities.

For the development and management of such innovative projects, it is necessary to apply modern methods of mathematical modeling based on functional modeling of innovation processes [13].

For the successful implementation of the innovation process, it is necessary to perform the following consecutive steps: systematize incoming ideas of innovations, formulate ideas of a new product, analyze the economic efficiency of a new product, create a new product, test a new product on the market, and decide on launching a new product into production.

At the initial stage of the innovation process, it is necessary to systematize the incoming ideas of innovation. Company activities, such as, for example, marketing or research, contribute to the accumulation of ideas for further innovation and their systematization. As soon as an opportunity or need for innovation arises, the innovation cycle begins.

At the first stage of the innovation cycle, it is necessary:

- to collect information that covers technological changes in the market, innovations received from research and development departments and marketing services in production departments;
- to study and analyze the wishes, requirements and complaints that come from consumers in the sales office of the enterprise, as well as from resellers and customers;
- to collect information on the permissible potential of the company in areas related to the development and development of new products;
- to determine the types of risks, the levels of their impact on the expected results of production and the introduction of innovations;
- to collect and analyze information on target markets and possible options for their development related to innovation.

To successfully analyze the economic efficiency of new products, it is necessary to formalize the idea as an investment project to create a new product with a preliminary assessment [14, p. 59]. To formulate a project, it is necessary to determine the technical and economic characteristics of the products (projects), assess their quality and consumer properties. After that, it is important to correctly assess (predict) the potential market demand and sales of the products offered. These actions allow you to create a preliminary program for the creation of new products and its development in production. On the basis of this program, further evaluation and determination of how much to invest in the creation and organization of the production of these products, as well as to determine the payback period. Taking into account all the information collected at the final stage, it is necessary to analyze and evaluate the profitability (profitability) of the production of new products and develop a program of marketing activities for this product [15, p. 74].

To create new products, the management of an enterprise needs to make an appropriate decision based on the marketing programs of this product containing complete information about the product, taking into account the feasibility studies, analysis of market data and the impact of this product on the overall economic performance of the enterprise. All activities of the enterprise related to the development of production are included in this stage, during which it is necessary:

1. Develop a program or a specific project to create new products.

2. Implement a program (project).

3. Create a test sample and test it to check its technical characteristics, production technologies, safety checks, including environmental ones.

4. To determine the name, trademark, design, packaging, labeling and other issues related to the design of new products as products of the company. In addition, it is necessary to test a new product on the market for parameters such as price and other commercial conditions in a limited market for a limited time (but not less than 3 months).

The most significant for the organization of the innovation process is the material and technical base of scientific and design developments. Rational construction and management of innovation processes depend on optimizing the costs of creating innovations, the timing of their implementation, as well as market opportunities.

An effective tool for managing the process of introducing innovations can be to control the transition from one operation of the innovation process to another. On the other hand, some operations of the innovation implementation process should be represented as isolated elements, the entrance to which is the result of previous operations, and the output is the products of this stage.

The success of innovation is largely determined by the degree of smooth passage of the logical chain of operations. This can be achieved by coordinating adjacent blocks during the transition from one operation to another. For this, it is

unimportant to stimulate the organizations responsible for the relevant operations.

State regulation in the country of innovation is still not effective enough. The quality of customs and tax and regulation, administration in relation to the innovative business is improved, but their fiscal component also prevails over the stimulating component. There is a low demand for innovations in the republic, as well as a significant margin in the direction of purchasing finished equipment abroad to the detriment of the introduction of their national new technologies or developments. Neither the state nor the private sector show sufficient interest in introducing innovative technologies [16].

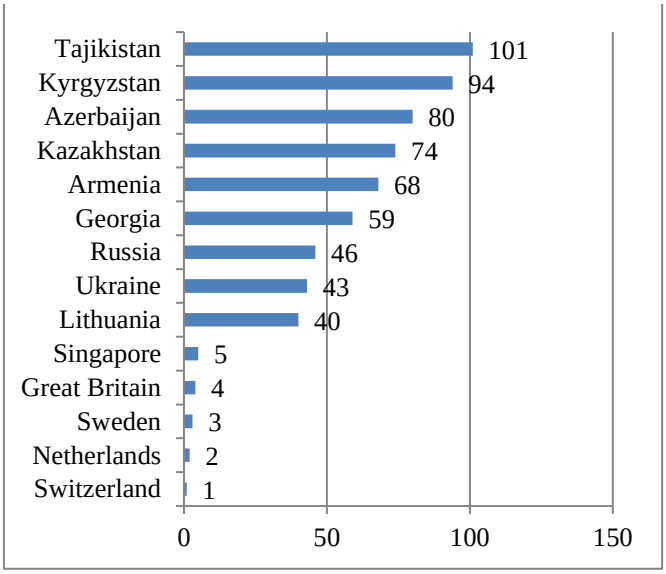

Fig. 6. Rating of the countries of the world according to the 2018 innovation index [11], [17], [12]

Analyzing the innovation activity of our country, which ranks 74th in the world in the innovation index for 2018, while Russia is in 46th place, and in the first place is Switzerland.

IV. Conclusion

In general, in the development and implementation of innovation policy in Kazakhstan, two types of problems are singled out - methodological and organizational [17].

Methodological problems are based on such positions as:

1. development of innovation policy, based on the theory of free market relations and minimization of state participation in the functioning of this market, which leads to the rejection of an active industrial policy;

2. the lack of a unified, methodological, evidence-based approach at the state level in the country for the transition to innovative rails, which is reflected in a significant number of developed and adopted program and regulatory documents that contain inconsistencies and contradictions in solving defined tasks;

3. understatement of the role and importance of state academies of sciences, which are the main producers of new fundamental knowledge, which are part of the elements of the system of institutes of innovative development of the state.

Organizational problems include:

1. systematic changes in the state science management system, liquidation of the majority of institutions that ensure integrity in the field of research and development, the conduct of a unified scientific and technical policy by the state;

2. the lack of constructiveness in the interaction of departments and ministries that are responsible for the development and implementation of innovation policies in conjunction with the business community and the academic research sector;

3. the unsuitability of the system of republican statistics to the goals of managing the scientific and technical sphere, the list of statistics indicators does not reflect the main parameters of the development of innovations and does not correspond to the tasks of the present time.

4. the lack of information on the effectiveness of the implementation of government measures to stimulate university science and innovations, to finance research and development, to create an innovation infrastructure, etc.

But the main problem is the breakdown of links between the main participants of innovation activity, low motivation and informational opacity. Many state programs regarding regulation of innovation activities in a country are often declarative in nature, and there are no practical mechanisms for their implementation.

As for cross-country comparisons of the cost of technological innovations, 10% of them are allocated for research and development in Russia, 50% in Germany, 65% in Sweden, and almost 70% in France. The absolute costs of technological innovation countries at par in Russia in 2000 were on average 3.5-5 times less than the purchasing power of national currencies than in Germany, 2-2.5 times less than in the UK, B 2- 2.5 times - than in France, 4-4.5 times - than in China. Over the past 10 years, China has increased spending on research and development in dollar terms by more than 8 times, Russia - by a little more than 2 times. Statistical data on research and development in Kazakhstan in the years when academic, former branch design institutes were in a deep crisis and even in a state of decay, most of them are incorrect and not comparable even with the CIS countries, Russia.

In general, ensuring the effectiveness of innovation policy in many ways requires solving such tasks as:

• giving social orientation to the policy of innovation (in terms of increasing the quality of life) and the strategy of innovative development of the republic;

• support (primarily financial) of the academic science of the republic, which determines the competitive advantages in the country;

• organizational reforming of the educational system as a necessary component to ensure the integrity of the country, not reducing the educational network, but expanding it (primarily in rural areas);

• formation of modern high-tech enterprises with state participation, in particular, on conditions of private-state partnership and commercialization of the results obtained;

• stimulation of industrial cooperation in the field of research and development, as well as industry and academic science;

• organization of the effectiveness of the interaction of the scientific, educational, industrial sectors and authorities;

• recognition of the significant role and development of the local level of the innovation system of the country;

• determination of priority directions in the state industrial policy and their direct financing from the budget of the republic;

• changes in personnel policy in the state economic sector with the involvement of highly qualified specialists;

strengthening control over the functioning of innovation infrastructure facilities, conducting systematic monitoring and evaluation of the effectiveness of financing by the budget of innovation processes (including republican target programs).

When analyzing the indicators of the global competition index "Technologies and Innovations", it should be noted that:

• firstly, state support aimed at the formation and development of innovation activity is not only justified, but also from the point of view of the economy, extremely important;

• secondly, the issues of innovative development in the near future can no longer be solved only at the state level; manifestation of passivity on the part of business structures (technical regulations and standards, demonopolisation of markets and the development of competition, strong business associations and trade unions, chambers of commerce and industry) can lead to a loss of position in the competitiveness index;

• thirdly, the key asset of the innovation economy - the presence of specialists with technical education, in this regard, it is very important to develop measures to support the "Young University Enterprise" Program, to form a national model of innovative education that meets international standards; the formation of a new generation of innovators aware of the risks and opportunities;

• fourth, the activity of "business angels", whose main task is to attract potential investors willing to invest in projects with a long payback period (venture capital), is a priority;

• fifth, the principles embodied in the model of stimulating the proposal of innovation (SSI) and the model of stimulating the demand for innovation (DDI) should play an ever-increasing role in the future. The choice of these models of innovation development as a whole is promising, their use can become the basis for building the strategy of the third industrial revolution - what the President of the country spoke about in his Address to the people of Kazakhstan this year.

The effectiveness of the innovation policy of the state, the ways of its creation, the main directions of support for the processes of innovation are largely reflected through leadership in science and technology. This leadership is manifested on an international scale: expansion of the export of information scientific and technical results (licenses, patents, etc.), an increase in the export of ready-made innovations. Leadership in science and technology is evidence of the correct course chosen and actions in connection with the formation and conduct of innovation policy by the state, as well as the choice of directions for development and research. The right choice can lead to a leading position in those aspects in which a country has a development priority.

The indirect incentive measures can also include the mechanism of venture financing, the development of the market of scientific and technical products, the formation of the innovation infrastructure in the country, the formation of clusters in the innovation sphere, which combine small and medium-sized and large firms, organizations in the research sector, operating in a particular area or geographic region.

In general, the significance of government intervention lies in the state recognition of innovation as determining the growth of a country's economy. At the same time, the state has an active role in the creation and financing of important programs, the implementation of which is of significant importance in the development of the country's economy.

Managing innovative development of the enterprise, it is necessary not only to concentrate on the possibility of making a profit at any given time but also to take into account the prospects for its preservation and increase in the future. To do this, it is necessary to carry out an appropriate analysis and forecasting of the most expedient development trajectories of an enterprise, determining possible scenarios for its development and identifying the most important, crucial moments when it is necessary to make fundamental decisions to avoid crisis situations and to ensure sustainable development of the enterprise.

Thus, in the republic there is a significant scientific and technical potential, a large resource base, as well as the recognition of world experience of the effectiveness of state participation in innovation. Supporting innovation processes at the state level, modifying state innovation development programs and adjusting regulatory documents on the regulation of innovation activity, it is possible to provide an innovative breakthrough and, thus, dynamic post-industrial development of the republic.

So, summing up, we can say that the process of creating an innovative product is a sequence of certain actions that economic entities use to conceive, design a product and launch it into production.

Thus, the application of the economic and mathematical model of the strategy of innovation development in practice allows in the future to increase the scientific substantiation and effectiveness of management decisions that will regulate the innovation activity of high-tech enterprises in the long term. To model an innovative strategy of an enterprise, it is necessary to choose a system of indicators that not only characterizes various options for innovative development of an enterprise but also contains the possibility of its expansion, that is, its indicators should be calculated over time and depend on the control parameters.

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